Entergy

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 501 858 5000

0CAN010305

January 31, 2003

U. S. Nuclear Regulatory Commission
Document Control Desk
Mail Station OP1-17
Washington, DC 20555

Subject: Arkansas Nuclear One – Units 1 and 2
Docket No. 50-313 and 50-368
Response to Request for Additional Information regarding use of Metamic®
Poison Panels in the Spent Fuel Pool

Reference: Entergy Operations, Inc. Letter No. 0CAN080201 to the NRC, "Use of Metamic® in Fuel Pool Applications," dated August 8, 2002

Dear Sir or Madam:

On August 8, 2002, Entergy Operations, Inc. (Entergy) submitted to the NRC a topical report, "Use of Metamic® in Fuel Pool Applications," prepared by Holtec, International. Entergy requested that the NRC review the Holtec report for the purpose of licensing Metamic® poison panels for use in the spent fuel pools at Arkansas Nuclear One (ANO).

Subsequent to that submittal, Mr. Tom Alexion of your staff forwarded to Entergy a request for additional information regarding the Holtec report. The attachment to this letter provides the requested information.

If you have any questions or require additional information relative to this topic, please contact me. This submittal contains no new commitments.

I declare under penalty of perjury that the foregoing is true and correct. Executed on January 31, 2003.

Sincerely,

Sherrie R. Cotton

Sherrie R. Cotton
Director, Nuclear Safety Assurance

SRC/rhs
attachment

A001

cc:

Mr. Ellis W. Merschoff
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

NRC Senior Resident Inspector
Arkansas Nuclear One
P.O. Box 310
London, AR 72847

U.S. Nuclear Regulatory Commission
Attn: Mr. William Reckley MS 0-7 D1
Washington, DC 20555-0001

U.S. Nuclear Regulatory Commission
Attn: Mr. Thomas W. Alexion MS 0-7 D1
Washington, DC 20555-0001

Mr. Bernard R. Bevill
Director, Division of Radiation
Control and Emergency Management
Arkansas Department of Health
4815 West Markham Street
Little Rock, AR 72205

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION RELATED TO THE TOPICAL REPORT SUPPORTING THE USE OF METAMIC® IN SPENT FUEL POOL APPLICATIONS ARKANSAS NUCLEAR ONE, UNITS 1 & 2

Question 1: Appendix "A" describes the technical assessment of the B_4C distribution in Metamic®.

One source of areal density variation across a plate of Metamic® is variation in thickness across the plate. How does the areal density variation change with respect to the increase in thickness variation due to the manufacturing of larger panels? How were these areal density measurements obtained?

Response:

The B_4C content of Metamic® is uniformly distributed in the 6061 aluminum. Therefore, the areal density variation of a Metamic® plate is directly proportional to the thickness of the plate. Areal densities are determined by neutron transmission tests of the Metamic® plate.

Question 2: General questions on testing:

a. How often were each of these tests performed? What is the reliability of the data acquired?

Response:

Although the specific number of tests is not known, each of the tests was performed in accordance with a test schedule and under the provisions of applicable portions of a quality assurance program which included provisions to verify the reliability and repeatability of the data (see Att.2, pages A-4, A-5).

b. Are there any full length inserts currently used in spent fuel pools? If so, were there any tests and/or inspections performed on these inserts? What were the results of these tests and/or inspections?

Response:

Entergy is not aware of the installation and/or use of full-length Metamic® inserts in spent fuel pools at other facilities.

Question 3: The physical properties and testing of Metamic® samples are described on pages 6-10 of Attachment 2 to the application dated August 8, 2002.

a. **Page 6 describes slight darkening observed on some of the coupons tested. What are the possible causes of this discoloration? Were there any other physical changes observed such as blistering, peeling, or cracking of the coupons?**

Response:

The cause of the discoloration was the oxidation of the aluminum surface of the Metamic®. Since there is more aluminum in the 15 w/o material than the 31 w/o material, darkening would be more prevalent in the 15 w/o material. No other physical changes were observed.

b. **The areal density of the coupons was stated to have no changes for both short-term and long-term testing. Describe how the areal density was determined for the coupons before and after both short-term and long-term testing. Include details on the areas tested, the technique, and the instrumentation.**

Response:

The areal densities of the Metamic® coupons used for both the short-term and long-term testing were determined by neutron transmission measurements. These measurements were made using standard industry techniques which utilize a beam of thermalized neutrons from the thermal column of a research or test reactor with a neutron counter. The measurements included a count of the direct beam with no absorber in place between the beam and the counter, a count with the Metamic® (or other) coupon in place, and, finally, a background count with a very strong absorber in place between the beam and the counter. These three measurements were used to calculate the transmission (or absorption) of the coupon. All measurements were performed with a sufficient counting interval to obtain the desired statistical confidence limits. (see Att.2, pages A-4, A-5).

c. **The description of mechanical properties on page 7 states that the coupons not subjected to elevated temperatures were used for pre-test data. Are these coupons from the same lot as those coupons used for all tests; i.e., short-term and long-term tests?**

Response:

The lot numbers of the coupons used for the various tests were not reported. However, measurable differences between lots would not be expected since they were manufactured under strict quality controls.

Question 4: The corrosion testing of Metamic® is described in pages 11-15 of attachment 2 to the application.

a. **Were there any considerations for this testing to account for fluid movement, temperature fluctuations, radiation dose changes, and intermittent scratching of the surfaces at different instances during the test? If so, provide details of these considerations and their impact on the results.**

Response:

Fluid movement due to natural circulation is an inherent feature of the tests. Because of this, some coupons were enclosed in stainless steel capsules to simulate the semi-stagnant conditions around some neutron absorbers in spent fuel storage pools. Temperature fluctuations occurred with all coupons when groups of the coupons were pulled and examined at the three interim times during the testing. The pulling and examination of the coupons subjected them to possible scratching and abrasion, but there was no effort to intentionally scratch the surfaces when removing the coupons. The coupons included in the corrosion testing program were not subjected to radiation, but the performance of Metamic® under irradiation was investigated in other tests.

b. **Details on the coupons tested are provided in a table on page 11 of Attachment 2. Provide details on the nature of the general scratches on the anodized Metamic® coupons. How were these scratches created? How long was each scratch? How deep was each scratch? Were there any residual metals found in the cracks prior to testing?**

Response:

The scratches on the surfaces of the anodized Metamic® coupons were made with a scribe and were applied by hand. The scratches were random in length and depth but each was deep enough to penetrate the anodic layer. No residual metals were found in the cracks prior to testing and testing resulted in the rapid oxidation of the 6061 aluminum exposed by the removal of the anodic layer. There was no corrosion within the limits of detection, and scratches have had no observable effects on the corrosion of Metamic®.

c. **Discuss why the distribution of the coupons tested is weighted towards the 15 w/o coupons. Is there an expectation that the results of the 15 w/o coupons can be extrapolated for the 31 w/o coupons? If so, what is the basis for this expectation?**

Response:

The distribution in the coupons tested was weighted toward the 15 w/o Metamic® because that was the predominant loading of the material available at the time of the tests. The results of the tests on the 15 w/o material are applicable to Metamic® of higher loadings for the following reasons. Metamic® consists of only two materials, 6061 aluminum and B_4C. Since B_4C is a completely inert material, corrosion of the 6061 aluminum would tend to be enhanced by a higher content of aluminum (lower B_4C content) in the samples. Therefore, the corrosion behavior of the 15 w/o Metamic® would be readily and conservatively extrapolated to Metamic® of higher B_4C contents.

d. What types of chemicals were used to clean the coupons in order to remove impurities prior to anodizing? How "limited" were the local pits formed as described on page 13 of Attachment 2? On what samples were these pits formed? Were there some areas of preferential pitting on the samples?

Response:

The Metamic® coupons were cleaned using an initial alkaline wash followed by a demineralized water rinse and a final treatment with a dilute nitric acid solution. Alternately, a glass beading process was used. The chemical cleaning did not result in the formation of the local pits. The pits formed in the very limited, localized spots in which the chemical cleaning did not completely remove the impurities. The pitting occurred when the Metamic® samples with residual surface impurities were subjected to the subsequent corrosion testing. There were no areas of preferential pitting observed on samples where pitting did occur because the distribution of impurities on the Metamic® surfaces was random. In any case, there is no indication that limited, localized pitting reduces the neutron absorption properties of Metamic®.

e. What were the material changes of the general coupons with scratches? Were there any weight changes? Any changes in B_4C density? Was there any blistering, cracking, or flaking visible?

Response:

There were no significant differences in the corrosion behavior of coupons with or without scratches. There were no weight changes, no changes in B_4C areal density, and no blistering, cracking, or flaking observed. (see Section 4.2)

f. Were there any gases released during the formation of the oxide layer on the coupon; i.e., was bubbling observed coming from the coupon?

Response:

The coupons were not visible during the course of the test. However, the passivation reaction of aluminum in water generates a gas. Since very little material is involved, very little bubbling occurs. Any bubbling that does occur soon ceases. Bubbling in Metamic® is less than that from Boral.

Question 5: The resistance of Metamic® to radiation damage is described in pages 16-18 of Attachment 2 to the application.

a. What is the basis for the statements made in the second paragraph of page 17? What is the typical "higher radiation dose" referred to in those statements?

Response:

The radiation dose of principal concern when evaluating metals for use in nuclear applications is that received from high-energy fast neutrons. The fast neutron flux seen by structural metals located near a reactor core, when integrated over long periods of time, can cause embrittlement of structural materials. This embrittlement causes an increase in the nil-ductility transition (NDT) temperature of the metal which can rise to values that complicate the operation of reactors whose designs include the use of a pressure vessel. These processes generally affect metals at fast-neutron doses (nvt values) that actually will be reached in the ongoing radiation testing of the Metamic® coupons in the Ford Nuclear Reactor (FNR) at the University of Michigan. (One packet of coupons being tested at the FNR has already received exposures up to 5.8×10^{19} nvt, so there will be additional data regarding the properties of Metamic® under these conditions.) However, radiation environments in spent fuel storage pools are much less severe than those experienced near a reactor core, so Metamic® in a spent fuel pool, over the lifetime of the pool, will never reach exposures even remotely approaching those already attained by the coupons being tested at the FNR.